

## Supporting Information

Superior inorganic ion cofactors of tetraborate species attaining highly efficient heterogeneous electrocatalysis for water oxidation on cobalt oxyhydroxide nanoparticles

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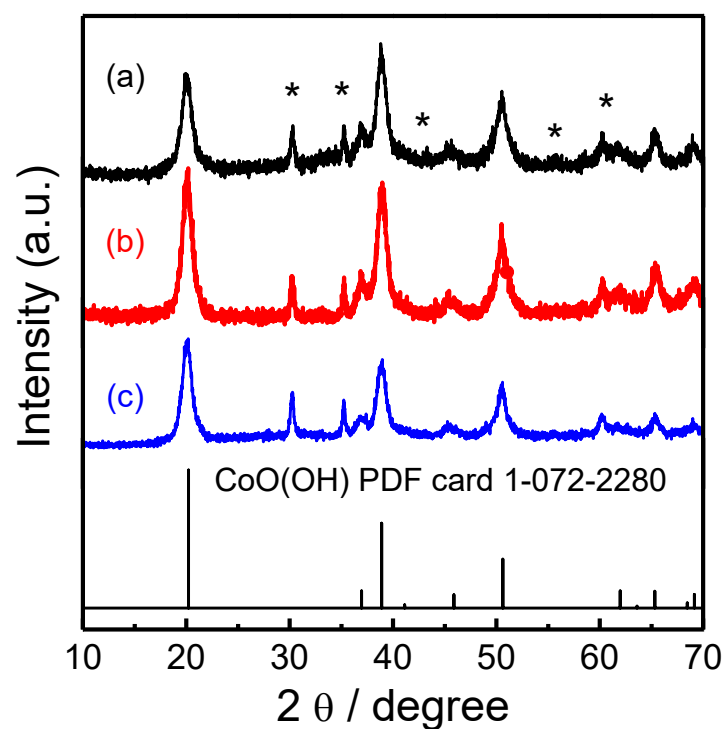
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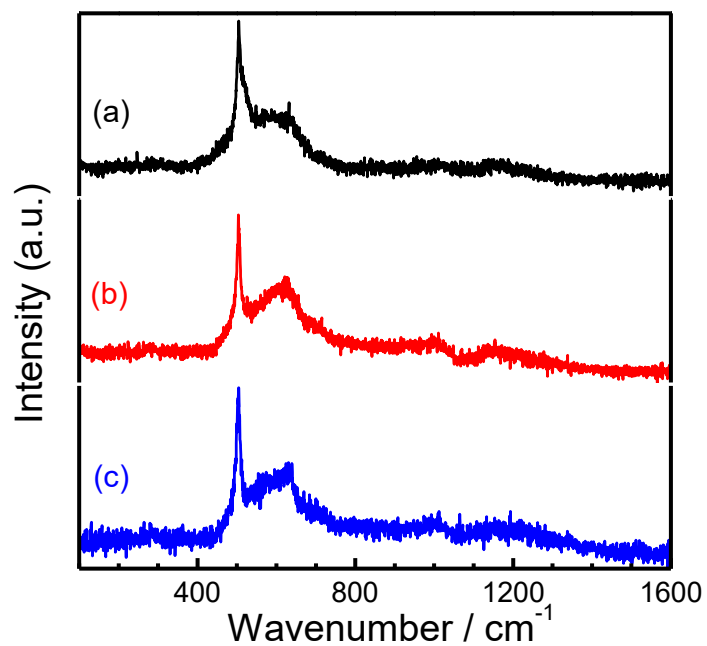
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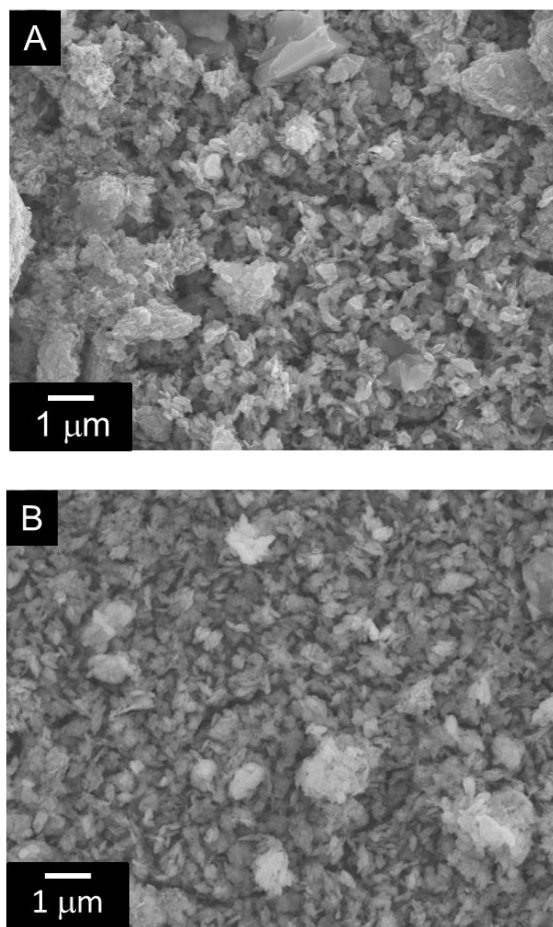
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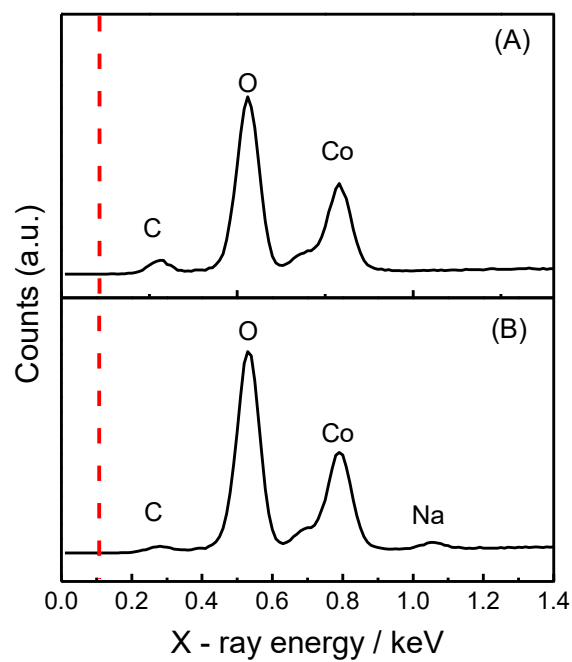
**Figure S1.** XRD patterns of a CoO(OH)/ITO electrode (a) before and (b, c) after bulk electrolysis for water oxidation at 1.7 vs. RHE for 3 hours in 0.1 M  $\text{Na}_2\text{B}_4\text{O}_7$  (b) and 0.1 M  $\text{K}_2\text{SO}_4$  (c) aqueous solutions at pH 9.4. The pattern of an ITO substrate was indicated by asterisks.



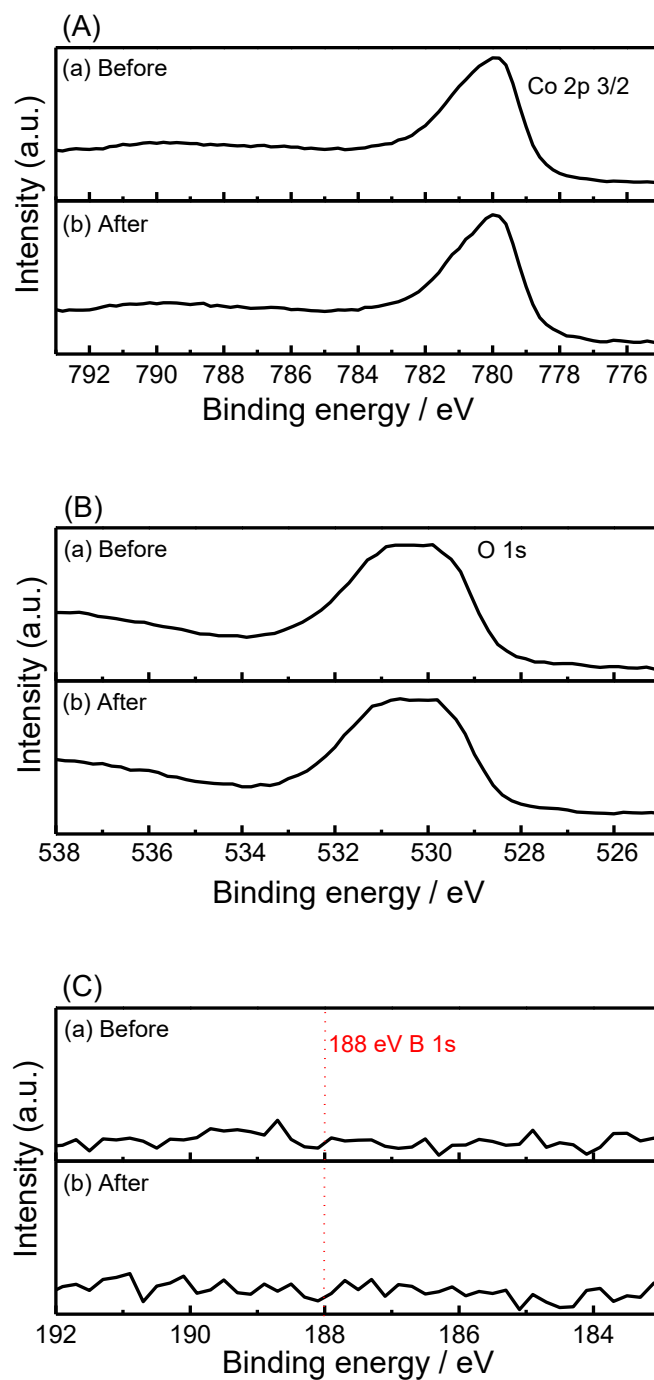
**Figure S2.** Resonance Raman spectra of a CoO(OH)/ITO electrode (a) before and (b, c) after bulk electrolysis for water oxidation at 1.7 vs. RHE for 3 hours in 0.1 M Na<sub>2</sub>B<sub>4</sub>O<sub>7</sub> (b) and 0.1 M K<sub>2</sub>BO<sub>4</sub> (c) aqueous solutions at pH 9.4.



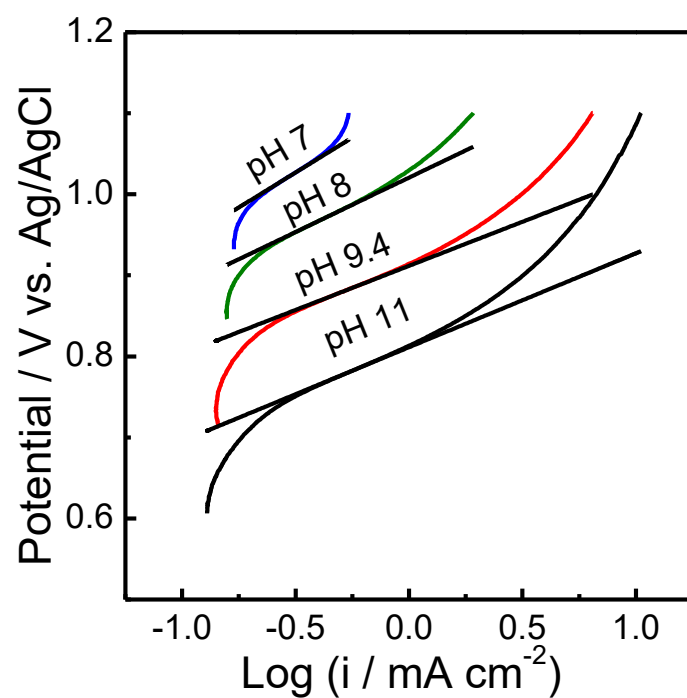
**Figure S3.** FE-SEM images of a CoO(OH)/ITO electrode surface (A) before and (B) after bulk electrolysis for water oxidation at 1.7 vs. RHE for 3 hours in a 0.1 M Na<sub>2</sub>B<sub>4</sub>O<sub>7</sub> solution at pH 9.4



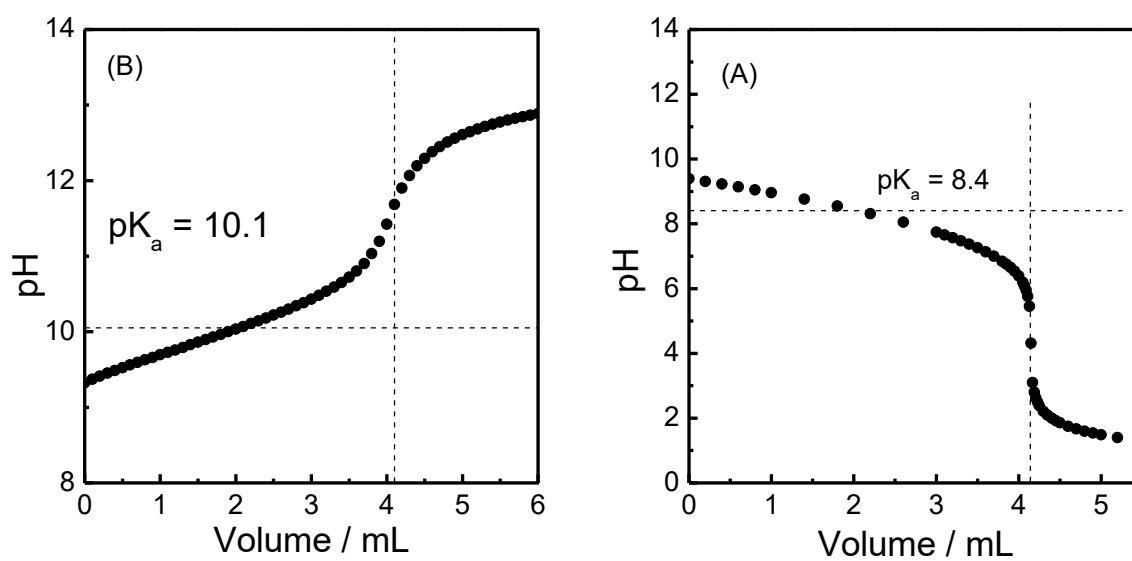
**Figure S4.** EDS spectra of a CoO(OH) / ITO electrode (A) before and (B) after bulk electrolysis water oxidation at 1.7 vs. RHE for 3 hours in a 0.1 M Na<sub>2</sub>B<sub>4</sub>O<sub>7</sub> aqueous solution at pH 9.4. The signal for B K $\alpha$  at 0.110 eV indicated by red dashed line was not observed.



**Figure S5.** XPS spectra of a CoO(OH) / ITO electrode (a) before and (b) after bulk electrolysis water oxidation at 1.7 vs. RHE for 3 hours in a 0.1 M Na<sub>2</sub>B<sub>4</sub>O<sub>7</sub> aqueous solution at pH 9.4. (A) Co 2p energy region, (B) O 1s energy region, (C) B 1s energy region.



**Figure S6.** Tafel plots for electrocatalytic water oxidation at a CoO(OH)/ITO electrode in 0.1 M Na<sub>2</sub>B<sub>4</sub>O<sub>7</sub> at different pH. The linear sweep voltammograms were measured at 0.5 mV s<sup>-1</sup>.



**Figure S7.** pH titration curves of a 0.1 M  $\text{Na}_2\text{B}_4\text{O}_7$  (20 mL) solution as a function of the volume of 1.0 M HCl (A) and NaOH (B) solution added.